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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/796,146	03/10/2004	Mizuhisa Nihei	040102	2043
23850 7590 01/05/2010 KRATZ, QUINTOS & HANSON, LLP 1420 K Street, N.W. Suite 400 WASHINGTON, DC 20005				
EXAMINER				
PHAM, THANHHA S				
ART UNIT		PAPER NUMBER		
2894				
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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary

Application No.

10/796,146

Applicant(s)

NIHEI ET AL.

Examiner

Thanhha Pham

Art Unit

2894

Period for Reply -- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 02 September 2009.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-17, 21-29 is/are pending in the application.
- 4a) Of the above claim(s) 11-17 and 21-29 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-10 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☐ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO/SB-08)
- 4) ☐ Interview Summary (PTO-413)
- 5) ☐ Notice of Informal Patent Application
- 6) ☐ Other: _____
- Paper No(s)/Mail Date 5/4/2009

DETAILED ACTION

This Office Action is in response to Applicant Amendment dated 9/2/2009.

Claim Rejections - 35 USC § 112

1. Claims 1-9 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention.

► With respect to claim 1,

limitation of "the first hole is completely filled with the bundle of carbon nanotubes of the heat conductor" is not supported by original disclosure

► With respect to claim 7,

limitation of "wherein the first hole is completely filled with the bundle of carbon nanotubes of the first heat conductor, and the second hole is completely filled with the bundle of the carbon nanotubes of the second heat conductor" is not supported by original disclosure.

The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

2. Claims 1-10 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

► With respect to claim 1,

It is not clear how the first hole can be completely filled with the bundle of carbon nanotubes while specification of pages 10-11 discloses the carbon nanotubes in the hole being formed by removing silicon elements from SiC substrate.

► With respect to claim 7,

lines 2-3, the limitation "a lower and an upper surface" should be changed to "a lower surface and an upper surface" to clarify scope of claim.

in addition, It is not clear how the first hole and the second hole can be completely filled with the bundle of carbon nanotubes while specification of pages 10-11 discloses the carbon nanotubes in the holes being formed by removing silicon elements from the SiC material of the SiC substrate

► With respect to claim 10,

lines 2-3, the limitation "the surface" lacks antecedent basis.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

3. Claims 1 and 7-8, as being best understood, are rejected under 35 U.S.C. 103(a) as being unpatentable over Arik et al [US 2005/0006754].

► With respect to claim 1, Arik et al (embodiment of figs 7-8, text [0001]-[0061]) discloses a semiconductor device comprising:

a substrate (204, text [0055]); and

a heat conductor (214, text [0056]-[0058]) formed in a first hole (microchannel 214) in the substrate and made of bundle of nanotubes (240) inherently oriented in a depth direction of the first hole,

wherein a diameter of the heat conductor is the same as a diameter of the first hole.

Embodiment of figs 7-8 of Arik et al does not specifically mention in written that:

- a) the substrate (204) is a SiC substrate; and
- b) the nanotubes (240) are carbon nanotubes.

In regard to a), embodiment of figs 7-8 of Arik et al, instead, teaches using the substrate being of a silicon substrate for sub-mount of a heat sink arrangement. However, Arik et al (text [0040]) also teaches that the silicon substrate and silicon carbide (SiC) substrate are equivalent substrates for sub-mount of heat sink arrangement. Therefore, at the time of invention, it would have been obvious for those

skilled in the art to use the SiC substrate, as being claimed, as a known and equivalent substrate for the sub-mount of the heat sink arrangement in the semiconductor device of embodiment of figs 7-8 of Arik et al to provide appropriate function of removing heat as being needed in the semiconductor device.

In regarding to **b)**, carbon nanotubes are known material for heat conductor. Selection of a known material based on its suitability for its intended use supported a prima facie obviousness determination in *Sinclair & Carroll Co. v. Interchemical Corp.*, 325 U.S. 327, 65 USPQ 297 (1945) "Reading a list and selecting a known compound to meet known requirements is no more ingenious than selecting the last piece to put in the last opening in a jig-saw puzzle." 325 U.S. at 335, 65 USPQ at 301. See also *In re Leshin*, 227 F.2d 197, 125 USPQ 416 (CCPA 1960) (selection of a known plastic to make a container of a type made of plastics prior to the invention was held to be obvious). In addition, Arik et al (text [0022]-[0026]) teaches using carbon nanotubes as known materials for heat conductor due to characteristics of highly thermal conductivity. Therefore, at the time of invention, it would have been obvious for those skilled in the art to use the carbon nanotubes as being claimed in the semiconductor device of embodiment of figs 7-8 of Arik et al to efficiently provide heat conducting function of the heat conductor in the semiconductor device.

► With respect to claim 7, Arik et al (embodiment of figs 7-8, text [0001]-[0061]) discloses a semiconductor device comprising:

a substrate (204, text [0055]) having a lower first surface and a upper second surface, the lower first surface being opposite to the upper second surface;

a first heat conductor (first heat conductor 214, figs 7-8, text [0056]-[0058]) formed in a first hole (first microchannel 214) in the lower first surface of the substrate and made of bundle nanotubes (240);

a second heat conductor (second heat conductor 214, figs 7-8, text [0056]-[0058]) formed in a second hole (second microchannel 214) in the lower first surface of the substrate to be spaced apart from the first hole in an interval, the second heat conductor being made of bundle nanotubes (240) inherently oriented in a depth direction of the second hole; and

an element (200, text [0055]) on the upper second surface of the substrate, wherein a diameter of the first heat conductor is the same as a diameter of the first hole and a diameter of the second heat conductor is the same as a diameter of the second hole.

Embodiment of figs 7-8 of Arik et al does not specifically mention in written that:

- a) the substrate (204) is a SiC substrate; and
- b) the nanotubes (240) are carbon nanotubes.

In regard to a), embodiment of figs 7-8 of Arik et al, instead, teaches using the substrate being of a silicon substrate for sub-mount of a heat sink arrangement. However, Arik et al (text [0040]) also teaches that the silicon substrate and silicon carbide (SiC) substrate are equivalent substrates for sub-mount of heat sink arrangement. Therefore, at the time of invention, it would have been obvious for those skilled in the art to use the SiC substrate, as being claimed, as a known and equivalent substrate for the sub-mount of the heat sink arrangement in the semiconductor device

of embodiment of figs 7-8 of Arik et al to provide appropriate function of removing heat as being needed in the semiconductor device.

In regarding to **b)**, carbon nanotubes are known material for heat conductor. Selection of a known material based on its suitability for its intended use supported a prima facie obviousness determination in *Sinclair & Carroll Co. v. Interchemical Corp.*, 325 U.S. 327, 65 USPQ 297 (1945) "Reading a list and selecting a known compound to meet known requirements is no more ingenious than selecting the last piece to put in the last opening in a jig-saw puzzle." 325 U.S. at 335, 65 USPQ at 301. See also *In re Leshin*, 227 F.2d 197, 125 USPQ 416 (CCPA 1960) (selection of a known plastic to make a container of a type made of plastics prior to the invention was held to be obvious). In addition, Arik et al (text [0022]-[0026]) teaches using carbon nanotubes as known materials for heat conductor due to characteristics of highly thermal conductivity. Therefore, at the time of invention, it would have been obvious for those skilled in the art to use the carbon nanotubes as being claimed in the semiconductor device of embodiment of figs 7-8 of Arik et al to efficiently provide heat conducting function of the heat conductor in the semiconductor device.

► With respect to claim 8, the claimed distance from the upper second surface of the SiC substrate to an upper surface of the second heat conductor relative (longer) to a distance from the upper second surface of the SiC substrate to an upper surface of the first heat conductor would have been obvious to an ordinary artisan practicing the invention because, absent evidence of disclosure of criticality for the range giving unexpected results, it is not inventive to discover optimal or workable ranges by routine

experimentation. In re Aller, 220 F.2d 454, 105 USPQ 233, 235 (CCPA 1955). Furthermore, it appears that these changes produce no functional differences and therefore would have been obvious. See In re Woodruff, 919 F.2d 1575, 1578, 16 USPQ2d 1934, 1936 (Fed. Cir. 1990).

Response to Arguments

Applicant's arguments with respect to claims 1-10 have been considered but are moot in view of the new ground(s) of rejection.

Conclusion

4. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

5. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Thanhha Pham whose telephone number is (571) 272-1696. The examiner can normally be reached on Monday and Thursday 9:00AM - 9:30PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Kimberly Nguyen can be reached on (571) 272-2402. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Thanhha Pham/

Primary Examiner, Art Unit 2813

